Skid Loader Boom Extension

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Problem Description

To satisfy a market need for a skid loader with an increased height capacity

Importance of project

An extension will allow the ability to stack hay bales higher than currently possible, utilizing full capacity of storage facilities.

Final Goal

Achieve 12 ft lift height while maintaining stability and load rating.

Objectives

- Perform finite element analysis on telescoping loader structure
- Use statics to determine proper balance
- Incorporate new hydraulic components
- Build functional prototype

Design Components

Structural Extensions inside current lift arms.
Hydraulic system to control extension
Center of gravity calculations for ballast
Electrical hydraulic control
Prototype Manufacturability

#	List of Activties	Planned Start	Planned Dur	Actual Start	Actual Dur	% Done
3	**Prototype Production**	1	16	1	8	100%
4	Equipment List	5	2	5	3	100%
5	**Purchase Equipment**	6	2	6	4	100%
6	**Bring Skidloader to Purdue**	2	1	2	1	100%
7	Measurements	3	12			100%
8	**Check System Capabilities**	3	2	3	3	100%
9	**Modify Loader Arms**	8	3	7	1	100%
10	Assembly Hydraulic Components	9	4			100%
11	**Counter Balance**	10	5			100%
12						0%
13						0%
14	**Design**	1	16	1	8	100%
15	**Free body Diagrams**	3	2	6	1	100%
16	Hand Calculations	4	3	4	3	100%
17	**Ansys**	5	3	4	5	100%
18	Hydraulic Curcuit	4	2	6	3	100%
19	**Easy 5**	6	2	6	3	100%
20	Safety conciderations	1	16	1	8	100%
21						
23	**Presentation 1**	3	1	3	1	100%
24	Presentation 2	9	1	9	1	100%
25	**Presentation 3**	13	1	13	1	100%
28	Report	12	16			10%
29	**Poster Presentation**	15	1	15	1	0%
30	Final Presentation	16	1			50%

Show Gantt for: Planned — Show Status?

Design Methodology

Pro Engineer
Computer model to aid in Design
Conceptual image of Prototype
Allows for FEA to be performed in ANSYS

ANSYS
Stress and Deflection Analysis of new extension
Stress Analysis of original lift arms due to new loading.
Verification of Loading Conditions " Hand Calculations"

Hydraulic System
Design for application speed
Design for rated pressure and flow
Worst loading conditions

Counter Balance
Calculate center of gravity
Optimize location of weights
Limit weight of machine

Prototype Production
Modification of Machine
Fabrication of Extension arms
Integrating new Hydraulic System
Painting

Design Testing

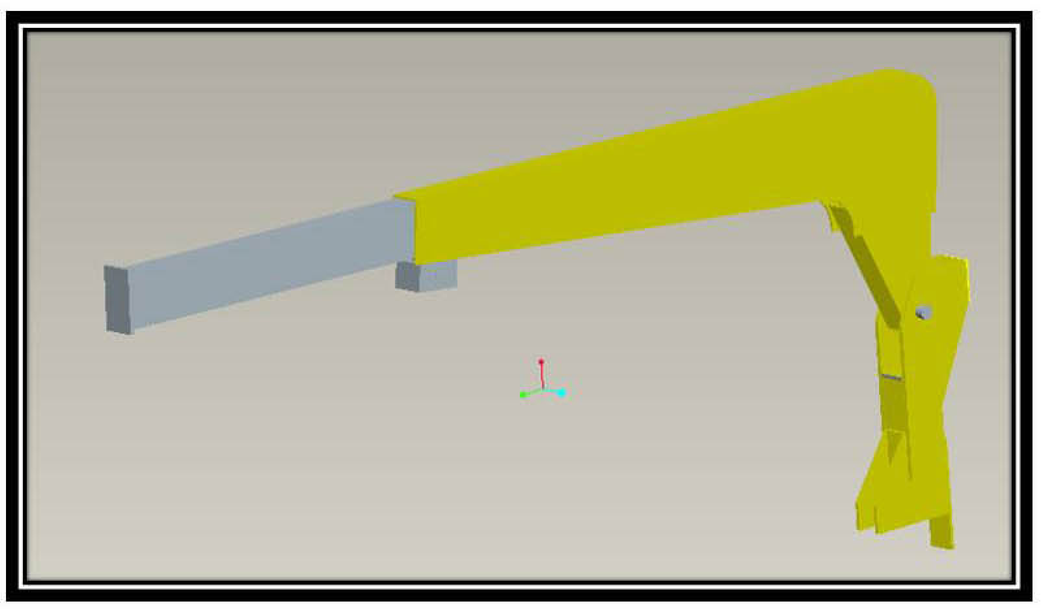
Flow rate Testing
Flow splitting tests
Extension Testing
Complete Prototype Testing
Counter Balancing Testing

Important Numbers

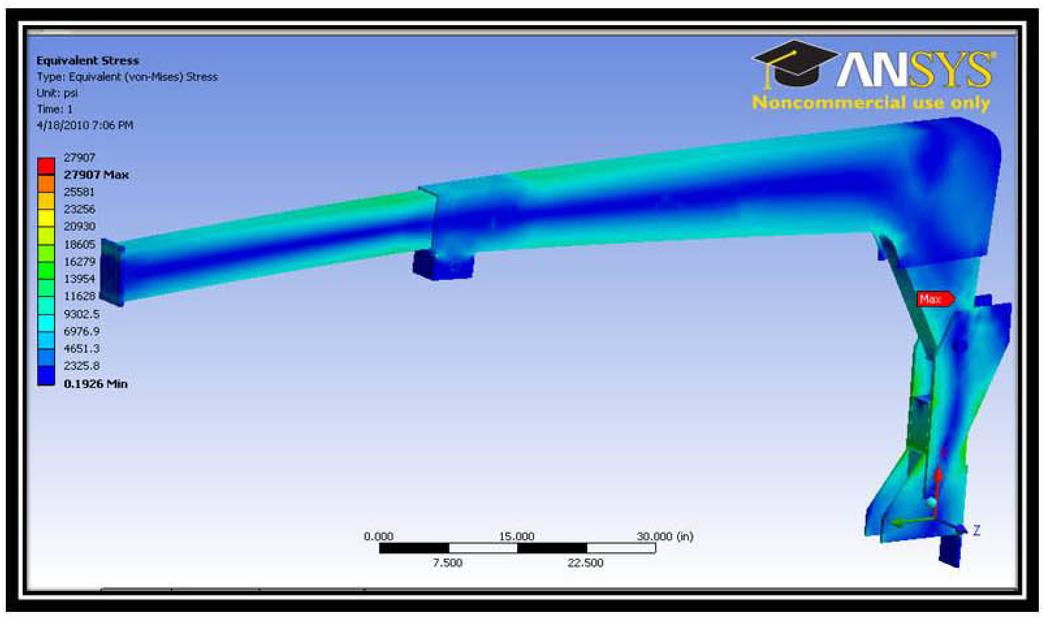
System pressure = 2500 psi
Rated Load = 1850 lbs
Design cycles = 150,000
Max deflection = .87in
Max Stress = 27,900 psi
Machine Weight = 4500 lbs
New Machine Weight = 5000lbs

First test of the hydraulic system

Important Calculations
•Beam Deflection
•Lift Force
•Hydraulic Flows
•Weld Calculations
•Center of Gravity



Pro Engineer computer model of the full structural design



ANSYS computer stress analysis of the full structural design

New hydraulic flow dividers and DCV

First test of the extension arms

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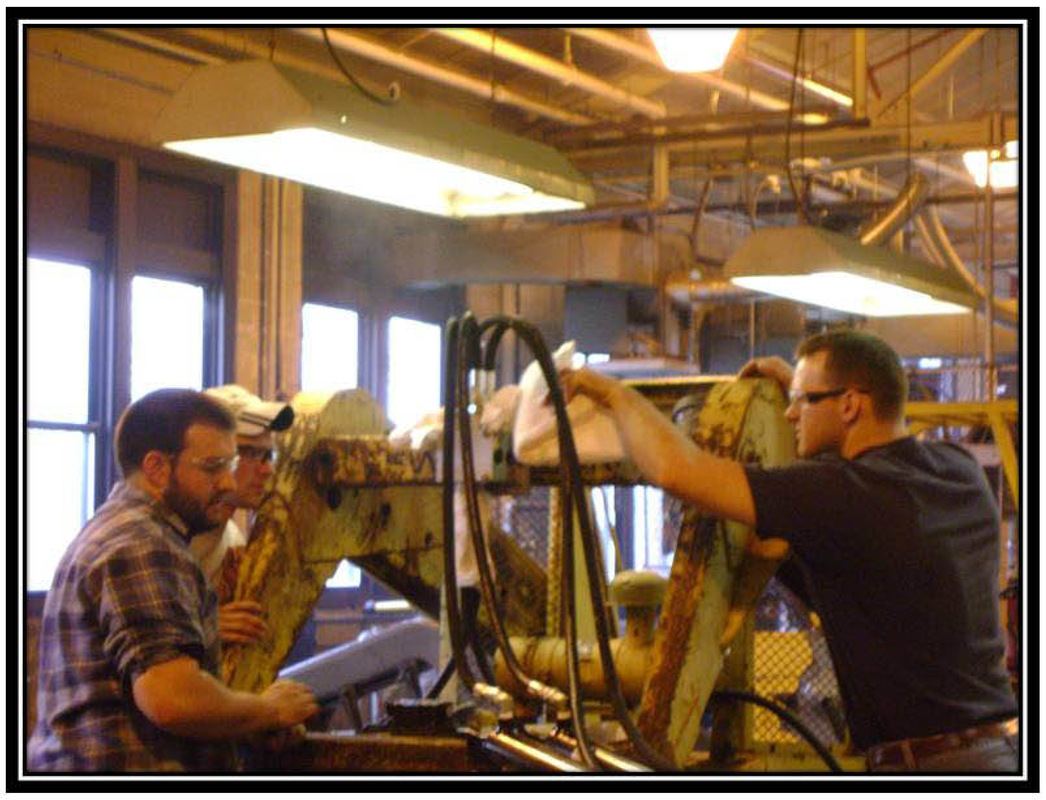


Bleeding air from hydraulic system

Final Prototype Checklist

Painting	Complete
Hydraulic system	Complete
Counter balance data	Complete
Mechanical structure	Complete
Electrical system	Complete

Complete machine before paint

Final load test

Conclusion

Working prototype that achieves a 12 ft work height.

A full extension of 3.5 ft.

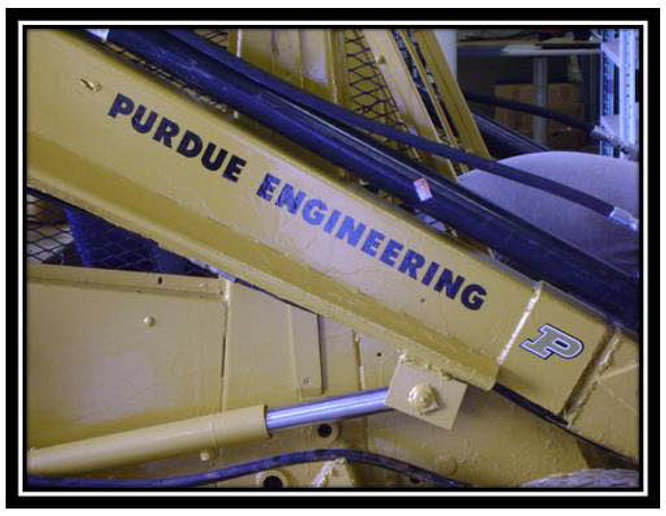
The machine's stability is maintained.

Market for new design
12% storage capacity in Hoop Barns

Total Cost for Modifications
$4050

Future Design Considerations

- Account for hydraulic fittings in design
- Design extension cylinders to be inside of extension arms
- Addition of a plastic wear plates inside extension
- Grease fittings for extension arms
- Incorporating a second torque tube



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